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Distinguished Lecture Series

QUANTUM CONTROL AS A MEANS TO IMPROVE QUANTUM SENSING IN REALISTIC ENVIRONMENTS

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IN THE JUNKER CENTER

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Quantum Control as a Means to Improve Quantum Sensing in Realistic Environments

Quantum technology, which harnesses quantum physics as a resource, is likely to be as transformational in the 21st century as harnessing electricity was in the 19th. Presently, research teams are exploring a range of opportunities to exploit quantum mechanics in new applications. One of the most promising areas is quantum sensing, where the greatest weakness of quantum systems - what makes them fragile - is turned into a strength in the detection of weak signals such as magnetic and gravitational fields. However, various signals interfere with a target to be detected, including ambient broadband electromagnetic noise and instabilities induced by mechanical vibrations in realistic environments.

In this talk we will introduce the field of quantum sensing and describe how quantum control provides the key to extracting more - and more useful - information for a range of applications in stando detection and precision navigation and timing. As our first example, we will introduce novel techniques for Magnetic Anomaly Detection developed by our team which permit the provably optimal suppression of out-of-band signals, allowing clutter rejection in complex environments. In addition, we will demonstrate how cleverly tailored quantum control solutions can improve the performance of atom interferometers, providing a means to suppress vibration-induced performance limits, and improving precision inertial navigation systems. Overall our work shows a pathway to dramatically enhancing the capabilities of standoff detection and precision navigation and timing in military settings through the use of quantum control.

ABOUT

Dr. Michael Biercuk

Michael J. Biercuk is Professor of Quantum Physics and Quantum Technology at the University of Sydney, and the CEO and Founder of Q-CTRL, a venture-capital-backed quantum technology company. In his academic role he is a Chief Investigator in the ARC Centre of Excellence for Engineered Quantum Systems through which his group is working to enable a new generation of quantum technologies by focusing on the role of control engineering in quantum-coherent systems. Michael earned his undergraduate degree from the University of Pennsylvania, and his Masters and PhD from Harvard University. He held a research fellowship in the Ion Storage Group at NIST Boulder, and has served as a full-time technical consultant to DARPA, helping to steer government investments in quantum information advanced computer architectures. Michael is a TEDx and SXSW speaking alumnus and winner of the 2015 Australian Museum Eureka Prize for Outstanding Early Career Researcher.